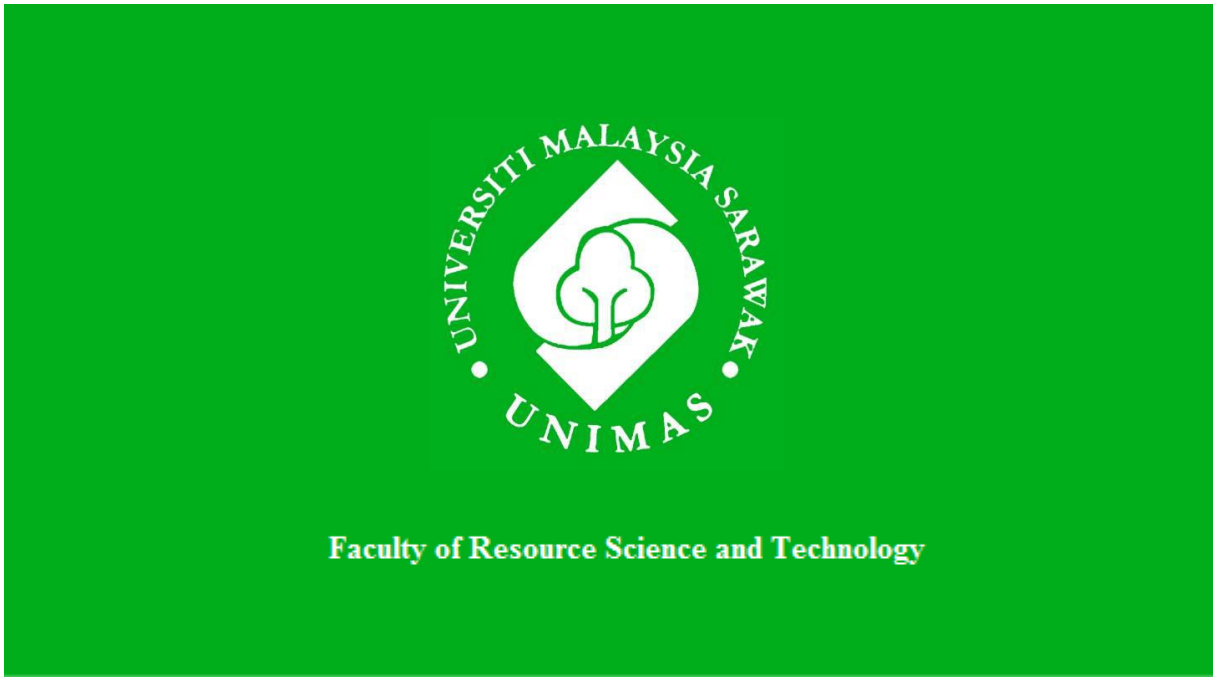

AQUATIC INSECT DRIFT AND FISH DIVERSITY OF SMALL STREAM AT KUBAH NATIONAL PARK, SARAWAK

MUHD NURZULKHAIRI BIN MOHD YUSUFF

Bachelor of Science with Honours
(Aquatic Resource Science and Management)
2015

UNIVERSITI MALAYSIA SARAWAK

Grade: _____

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Final Year Project Report ☒

Masters ☐

PhD ☐

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AQUATIC INSECT DRIFT AND FISH DIVERSITY OF SMALL STREAM AT KUBAH NATIONAL PARK, SARAWAK

MUHD NURZULKHAIRI BIN MOHD YUSUFF

This project report is submitted in partial fulfilment of the requirements of the degree of

Bachelor in Science with Honours

(Aquatic Science and Resource Management Programme)

Faculty of Resource Science and Technology

UNIVERSITI MALAYSIA SARAWAK

2015

DECLARATION

I hereby declare that no portion of the work referred to in this dissertation has been submitted in support of an application to another degree or qualification to this university or any other institution of higher learning.

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ACKNOWLEDGEMENT

Alhamdulillah, I am thankful to Allah S.W.T for His Blessings for giving me opportunities to finish this project.

First and foremost, I would like to thanks my supervisor, Dr Fazimah Aziz for giving me opportunity to do this Project under her supervision. She allowed me to encroach upon his precious time from the very beginning of this work till the completion. Her expert guidance, high level of patient, affectionate encouragement, caring advices and critical suggestion provided me necessary insight into the research problem and paved the way for this project to be done. I have no hesitation to say that, without this constant supervision and valuable advices and suggestion from time to time, I would not able to complete this project in efficient manner.

I would like to express my thanks to the chief lab assistant, En. Zaidi Ibrahim for his amazing skill in preparation of all the equipment and transportation used during the field work. I am highly indebted to the staff of Aquatic Departments, UNIMAS who are involved in the fieldwork especially En. Richard Toh and En. Nor Azlan Bujang for their resourceful assistance and full support in helping me during the fieldwork. I am very grateful for their help, this project could not be done without their expert experienced in conducting fieldworks. I am highly obliged to my collegague, Nur Fatihah bt Abdul Malik for her great assistance and help while conducting the fieldwork.

Thank you to the management of Kubah National Park for their kind cooperation and accommodation during my fieldwork.

Lastly, my deepest thanks to my family and my friends for their endless moral support, advices and prayers in keeping me motivated upon completing this project.

TABLE OF CONTENTS

LIST OF FIGURES

Figures Page

LIST OF TABLES

Tables Page

LIST OF APPENDICES

Appendices Page

Aquatic Insect Drift and Fish Diversity of Small Stream at Kubah National Park, Sarawak

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ABSTRACT

The present study aimed to determine the composition of aquatic insects and fish of small stream at Kubah National Park, Sarawak. The drift pattern exhibit by aquatic insects and its association with water parameter also was studied. Aquatic insects samples of the small stream were collected every three hours over twenty-four hour period using Surber sampler for five sampling study. Samples were collected every three hours along with the measurements of water temperature, pH, dissolved oxygen, turbidity, total suspended solids, water velocity and depth of water at the Surber sampler mouth. Members of the Order Diptera dominated the drift, accounting to 28% of the total drift, followed by members of the Orders Plecoptera and Trichoptera were the second and third most abundant groups, respectively. There were 91.75 individuals per 100 m^3 of volume water filtered. Total number of insect was significantly, positively correlated with dissolve oxygen and total volume of water filtered by the sampler. The drift of aquatic insects were most active during the mid-morning to mid-afternoon, 0900-1200 hour. Statistical test showed no significant differences between day and night drift densities although drift density is 0.5% higher during the daytime compared to nighttime. A total of 47 individuals of fish were caught comprising of Family Clariidae, Cyprinidae and Belontidae accounting to 45%, 42% and 13% respectively.

Keyword: Aquatic Insect, drift pattern, water quality, Kubah National Park, Sarawak.

ABSTRAK

Kajian ini bertujuan untuk menentukan komposisi serangga akuatik dan ikan di sungai kecil di Taman Negara Kubah, Sarawak. Corak hanyutan dipamerkan oleh serangga akuatik dan kaitannya dengan parameter air juga dikaji. Sampel serangga akuatik di sungai kecil telah dikumpulkan setiap tiga jam dalam tempoh dua puluh empat jam menggunakan penyampel 'Surber' sepanjang lima kajian persampelan. Pengambilan sampel dilakukan setiap tiga jam bersama-sama dengan pengukuran suhu air, pH, oksigen terlarut, kekeruhan, jumlah pepejal terampai, halaju air dan kedalaman air di mulut penyampel 'Surber'. Ahli daripada Order Diptera mengungguli hanyutan, menyumbang kepada 28% daripada jumlah hanyutan keseluruhan, diikuti dengan Plecoptera dan Trichoptera masing-masing adalah kedua dan ketiga keunggulannya. Sebanyak 91,75 individu bagi setiap 100 meter padu dikumpul daripada jumlah air yang ditapis. Jumlah bilangan serangga adalah nyata, positif berkorelasi dengan oksigen terlarut dan jumlah pelepasan air sungai yang ditapis penyampel 'Surber'. Hanyutan serangga akuatik adalah paling aktif pada pertengahan pagi hingga tengah hari, jam 0900-1200. Ujian statistik menunjukkan tiada perbezaan kepadatan hanyutan yang signifikan di antara siang dan malam, walaupun kepadatan hanyutan 0.5 peratus lebih tinggi pada waktu siang berbanding waktu malam. Sebanyak 47 individu ikan telah ditangkap yang terdiri daripada keluarga Clariidae, Cyprinidae dan Belontidae masing-masing menyumbang kepada 45 peratus, 42 peratus dan 13 peratus.

Kata Kunci: Serangga Akuatik, Corak Hanyutan, Kualiti Air

1.0 Introduction

Insects are very successful in the aquatic environment. This is displayed by their diversity and abundance, wide distribution, and their ability to exploit most types of freshwater habitat (Wallace and Anderson, 1996). According to Shabdin *et al.* (2001), species diversity of invertebrates in most part of the world, particularly in tropical nations, is deficiently known. Correspondingly, the lack of insight may be due to several reasons such as the numerous diversity and composition might contribute to them being overlooked during sampling and invertebrates are small and hard to distinguish (Harun *et al.,* 2010).

Aquatic insects play vital ecological roles that are essential for these ecosystems to function properly. Thus, aquatic insects are an important component of biodiversity (Braccia and Voshell, 2006). There are example of order of aquatic insects that composed strictly an aquatic species (i.e., species that have at least one life-history stage that is obligatorily aquatic): the dragonflies and damselflies (Odonata), the stoneflies (Plecoptera), the mayflies (Ephemeroptera), the caddisflies (Trichoptera), and the hellgrammites (Megaloptera) (Hauer and Resh, 2006).

C´er´eghino *et al.* (2004), stated that the flows of aquatic organisms from the upper part to the lower part of a river resulting from the effect of water velocity was defined as 'Drift'. Even though an argument remains to conclude if some species choose to severely drift onto the water column or unwillingly being flushed from the riverbed (Wilzback, 1990), drift is assumed to predominantly exhibit behavioral (active) process, which might influenced the decolonization of the organisms at downstream areas (C´er´eghino *et al.*, 2004).

Various field perceptions have exhibited that the drift of different stream insects display a diel periodicity, with immense drift density during night and low drift density during the day (C´er´eghino *et al.,* 2004). Diel periodicity is best define as, frequency of individuals drifting changes over a 24-hour period (Smock, 2006). Though, this may be a flexible feedback to decrease vulnerability to optically hunting, drift feeding fishes (Flecker, 1992). In many streams or rivers, fish are the top predators that search for sustenance on invertebrates that present on the stream bottom or drifting in the water column (Smock, 2006). Regarding the size structure, the high rate of drift densities during night were displayed by larger individuals thus it strongly support the hypothesis that most insect can actively control their entry towards drift (Smock, 2006).

Borneo is well known for its richness of the insect fauna and their high level of endemicity. Although much has been said about this, most of its insect fauna, still remain undocumented and unknown to science (Abang and Hanapi, 1999). This study was carried out to fill the gap on providing data of macroinvertebrate study specifically in Small River of Kubah National Park, Sarawak. According to Hayati *et al.* (2010), the earlier purpose of the establishment of National Park is to nurture and conserve the flora and fauna that are being the main interest by geologist, entomologist, ethnology, historian and other. National Park plays the main role in wildlife's protections, conservations of the nature and ecology system, as well as recreation and ecotourism practices.

Though, these questions needs further consideration. First, what is the composition of aquatic insects drift and fish in Kubah? Second, what are the dominant species of aquatic insects drift and fish in Kubah? Finally are there some specific drift pattern that are being exhibited by these organisms of the microhabitat preference?

Detailed studies on abundance and drift behavior of aquatic insects at this area are still severely lacking. This study was carried out with the following objectives (1) to determine the diversity and composition of aquatic insects drift and fish, (2) to study the drift pattern of aquatic insects (3) to determine the relationship between water quality parameters and drift density of aquatic insects.

2.0 Literature Review

2.1 Diversity and Composition of aquatic insects in freshwater

Insects are outstandingly organism that present in aquatic environment. This was shown by their various assortment and richness composition, expansive conveyance and the capacity to endeavor most types of freshwater habitat (Wallace and Anderson, 1996).

A study carried out by Rasdi *et al.* (2012) that was done in Keniam River National Park, Pahang, Malaysia from September 2009 to December 2010 showed that there was a vast diversity of aquatic insects belonging to at least 8 orders in the study area. The orders of the insects were Odonata, Coleoptera, Diptera, Trichoptera, Thysanuraa, Orthopthera, Hemiptera and Ephemeroptera. Results from the study also showed that a range from a total of 140 to 604 individuals of aquatic insect were trapped monthly and collected in Keniam River. They also described that the abundance and distribution of insects' species were varied and not constant from one month to another throughout the study period.

Another research was carried out by Harun *et al.* (2010), on comparison between three streams of Maliau Basin Conservation Area, Sabah, Malaysia. A total of 254 specimens representing 17 families from 8 orders were collected from Ginseng, Takob-Akob and Maliau Falls streams. The largest order, Ephemeroptera composed a total of three families and accounted for (27.17%) of the total number of aquatic discovered. It was followed by Coleoptera, the second largest order with six families (20.08%) and Plecoptera, which composed of only one family (17.32%). The lowest group was the order of Odonata that composed as low as five individuals (1.97%).

In Sarawak, a survey on the diversity of aquatic insects at four streams in Padawan Limestone was done by Grinang (2013). Around 42 taxa of aquatic insects were distinguished, with half of the total taxa were constituted by the order of Hemiptera and Odonata. *Baetis* sp. represented the order Ephemeroptera comprised of 42% of the total individuals.

2.2 Downstream drift of aquatic insects and their drift pattern

Drift is a movement whereby the aquatic insects entered the water column and flushed downstream simultaneously with the flows of water (Smock, 2006). Drift was characterized into 3 types which are behavioral drift that was expressed by characteristic behavior pattern resulting in a consistent diel periodicity (commonly at night), constant or natural drift was expressed by continuous existence of drift in low number of species and catastrophic drift, the drift that appeared from physical disturbances (Waters, 1965).

Wallace and Anderson (1996) found that the genus *Baetis* of the order Ephemeroptera, consistently showed high behavioral drift rates with a night-active periodicity. A study carried by Fazimah *et al.* (2005), also indicated the downstream movement of aquatic insects are actively occurred during the night as the phenomenon may reduce significantly during the day. They described that the drift pattern observed at the study site, Selai River, started to increase right after dust, increasing the frequency of individuals until midnight and remain high till dawn. Just after the sun rises, the number of organisms drift reduced suddenly and remain low throughout the day.

Matzinger and Bass (1994) made comparison between species richness of the day and night samples during a 24 h period of alternate months from March 1990 through January 1991. A significant difference was detected for all 24 h collections except in May. The study concluded that, flooding during May might have disrupted the normal drift patterns of many aquatic insects.

2.3 Factors that influence the drift of aquatic insect

The natural occurrence of drift is usually related to the abiotic factors such as discharge, daylight, velocity, substratum, water temperature, turbidity, and moonlight and several biotic factors such as predation avoidance, food availability and suitable habitat (dispersal) (Statzner *et al.*, 1985).

According to Pearson and Franklin (1968), they proposed that drift rates may have increased in response to an increase in temperature. A study carried out by Matzinger and Bass (1994), on their study of relation between water temperature and drift density showed that Ephemeroptera, Chironomidae, and Coleoptera were the dominant groups found in range of 25.9°C. Meanwhile, higher temperatures during summer in Oklahoma probably limited the Plecopterans from becoming more abundant as aquatic insects induced dormancy period during warmer month.

Pearson and Franklin (1968) also found that a sudden increase in turbidity was immediately accompanied by a rise in the drift rate of *Baetis* nymph. Many might drifted earlier from normal diel period as turbidity decrease light penetration (Matzinger and Bass, 1994).

Changes in ambient light intensity, although not the main reason for drift behavior, it serve as the trigger or phase-setting agent for drift as most species do have a threshold light intensity which the active drift may be initiated, as occurs at sunset (Allan, 1995).

2.4 Drift periodicity of aquatic insects and their relation towards fish predation

Drift usually display unique diel periodicity whereby the frequency of individuals drifting changes over a 24-hour period (Smock, 2006). Drift activity of stream invertebrates usually is greatest during the nighttime hours in running water throughout the world, which actually may be a flexible feedback to decrease vulnerability to optically hunting, drift feeding fishes (Flecker, 1992). A study conducted by Flecker (1992) showed that when drift periodicity was investigated along a gradient of predation regimes, aquatic insects' activity was found to be increasingly bias to the nighttime hours as predation risk become more intense. He also observed the diel periodicity even when fish were experimentally excluded, and the result revealed that, nocturnal activity of aquatic insects has evolved as a fixed behavioral response to predation. Thus, tendency of aquatic insects to exhibit nocturnal drift increase as the risk of predation by visual-feeding fish increases (Allan, 1995).

C´er´eghino *et al.* (2004), in their study of drift population structure of the mayfly *Rhithrogena semicolorata* showed that, most of the larger individuals were found to drift during night. In contrast, many larvae were found drift at the peak drift rate during the day, proving that there is significant difference between size-frequency distributions on aquatic insect drift. Smock (2006) described that many stream-dwelling fish are size-selective visual feeders, needing to see their prey to capture them and preferentially preying on larger individuals, thus aquatic insect's exhibit behavior drifting by accessing nocturnal drift

pattern. Thus, risk of predation by stream-swelling fish also affect the ‘size’ distribution of drifting aquatic insects, with larger individual being more prone to drift at night (Allan, 1995).

Study on selection of aquatic insects as food for fishes carried by Pinto and Uieda (2007) also described that, many species of fishes in open area have consumed a high quantity of the most abundant insect group which is Ephemeroptera, and showed that fishes consumed this resource as it the most abundance, and not because it is the favorite one.

3.0 Research Methodology

3.1 Study Site

This study was carried out at Kubah National Park, Sarawak. For the study site of this research, a small stream at Kubah National Park with GPS reading N01°36’35.6’’ E110° 11’23.0’’ (Figure 1) was choosen. The coordinate of the stream was recorded using global positioning system (GPS) (Garmin 60 cxs model). The bottom substratum of the stream was characterize by rocky substrate (>50%), consisting of pebbles, cobbles and boulders.

Figure 3.1: Sampling station at Kubah National Park.

3.2 Field Methodology

3.2.1 Sampling Period

The data collections was done from December 2014 to March 2015. The collections were carried five times, as each sampling was carried out 24 hours at the same station.

3.2.2 Aquatic Insects Collection

At the sampling station, a WILDCO Surber stream bottom sampler (Figure 3.2) was used. Two strands of rope was fixed on both sides of the frames to hold the net in position. The sampler was placed with its open end facing the current (Figure 3.3). Each sampling period was done 24 hours and the nets was emptied every 3 hour. The sampler net was flushed out from the outside into a pail. The water then was sieve with 250 micron sieve pan. The content of each sample was transferred into plastics bag. Each sample was preserved with 10% formalin and few drops of rose Bengal. Each samples was properly labelled with respective date and time. The samples then were taken back to the laboratory for analysis.